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ABSTRACT

This document reports an attempt to examine the content and structure of the domain of research and development (R&D) training resources. The project began by locating instructional materials within a larger matrix that classified R&D resources by structure (primary/secondary, oral/written, documentary/non-document) and level of formalization (formal, semiformal, informal), and content (instructional/non-instructional material). Examination of ERIC, "Books in Print," and three nonbook instructional materials collections indicated that there is roughly an "order of magnitude" ratio for the estimated quantities in these three bases. Extrapolation suggests that 90% of the educational R&D instructional resources are largely informal and fugitive. Perhaps 10% reach a semiformal level where they may be in published form and may be referenced. Possibly only one or two percent are published commercially in hard cover, and much less than one percent are subjected to the test of the R&D development cycle. Probably over 95% of all instructional materials are in printed rather than oral form. The number of fully developed and tested materials is probably well under 100 items; perhaps another 1000 items have undergone minimal development and informal testing or evaluation. The number of books and textbooks with reasonably direct bearing on R&D content is estimated at 10,000. Appended to this document are scattergrams of counts; a listing of RIE descriptors; and estimations of numbers of documents in RIE, CIJE, and "Books in Print." (Author/DDO)

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DESIGN OF A PERSONNEL AND TRAINING INFORMATION SYSTEM FOR EDUCATIONAL R&D PERSONNEL

THE DOMAIN OF R&D TRAINING RESOURCES

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EXECUTIVE SUMMARY

In July 1972, the Far West Laboratory for Educational Research and Development initiated a project designed to develop and test procedures to evaluate and disseminate information on training of educational research and development (R&D) personnel.

One aspect of the project called for the creation of matrices that would map the domain of R&D personnel and training information. As the project progressed, the sponsor's interest focused particularly on training materials. This document reports the author's effort to establish data-based estimates for the subject content and to design a format of educational R&D training materials.

After locating the area of specific investigation within the larger area of R&D information, estimates based on ERIC, Books in Print, and a combination of three instructional materials collections were examined in detail and compared to each other in 14 major subject-content categories. Examination of these data bases indicate there is roughly an "order of magnitude" ratio for the three bases. Extrapolation suggests that ninety percent of the educational R&D instructional resources are largely informal and fugitive. Perhaps ten percent reach a semiformal level where they may be in published form and may be referenced. Possibly only one or two percent achieve "hard cover" commercial publication and much less than one percent are subjected to the test of the R&D development cycle. Probably over 95 percent of all instructional materials is in printed form. The number of fully developed and tested materials is probably much less than 100 items; perhaps 1,000 have undergone minimal development and may be generally accessible although not necessarily easily so. And there are possibly 10,000 books and textbooks which bear on R&D training content as defined by the project. ERIC documentation suggests there are more than 40,000 relatively recent (1966-1972) journal articles and reports which provide the knowledge base for R&D training content. The total relevant published literature may be closer to 100,000 items.

There are significant but far from perfect content correlations among the three data bases. The ERIC descriptor counts prove to be better predictors of counts of nonbook instructional materials subject categories than do count of Books in Print. Almost all the instructional materials are located in classical "educational research categories," with only three of eleven major content categories containing over half of the books and textbooks and over forty percent of the nonbook instructional materials. By contrast only four percent of all instructional materials were classified in the two general content categories of (a) Design and Development and (b) Evaluation. However, examination of trends in ERIC as well as other evidence, suggest that the rate of growth may be greater in these less well-established but high interest areas.

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THE DOMAIN OF R&D TRAINING RESOURCES

I. INTRODUCTION

Training resources may be classified as actual or potential. Actual training resources are materials that have been specifically designed to serve instructional purposes such as textbooks, programmed workbooks, instructional films, etc. Potential resources are materials which have not been designed primarily to serve instructional purposes, but which can be adapted to meet instructional needs, or which may be used as a knowledge base to create instructional materials. Examples are journal articles, case studies, technical reports, etc. There is no clear-cut boundary, except possibly the intent of the author. Certainly, a well-written journal article may have more instructive potential than a poorly written chapter in a textbook.

Not only is there a problem in deciding what is an instructional material, there is also a problem in deciding what is an educational R&D instructional material. This raises the question of content. As we have noted elsewhere (Hood, July, 1973, p. 10), educational R&D has a "field-oriented" knowledge base, and derives its content from many disciplines. Consequently, the theory, methodology, art, and practice, which may constitute suitable content for instruction, extends into many areas apart from education. The determination of the boundaries for educational R&D content must be somewhat arbitrary.

II. THE DOMAIN OF R&D INFORMATION

A. Structure and Levels of Formalization

Because of the blurred distinctions regarding training resources and R&D content, it is useful to regard R&D training materials within the larger domain of R&D information. To do so, we shall review an earlier analysis (Hood,

McCutchan, Aldrich, and Wolf, 1972, pp. 70-77) in which structure, levels of formalization, and content were viewed as three major classification constructs.

Structure. Information may have many forms and formats. Primary information may include oral communication, primary documents (e.g., reports, journal articles, or conference papers), and primary nondocument items (e.g., instructional films or testing materials). Secondary information includes these sources: abstracts, annotations, bibliographic citations, indexed information, bibliographies, literature reviews, magnetic tape data, as well as directories, registers, and guidebooks (e.g., personnel directories, consultant registers, organizational directories, subject literature guides).

A secondary aspect of structure is the format or medium in which the information appears. Is it oral, documentary or nondocument in form? And, for each of these forms, what specific format does it have, e.g., if oral, is it a meeting, symposium, conference, seminar, telephone call, casual meeting, etc.?

Level of Formalization. This dimension may be roughly divided into three levels: formal, semiformal and informal. These levels can be associated with timeliness, accessibility, permanence, quality, and flexibility. Of course each of these characteristics could be treated as a separate dimension, but in general, they are all related to level of formalization. Each level has its advantages and disadvantages which have been outlined in some detail (loc. cit.).

B. Instructional Materials in the R&D Information Domain

Figure 1 maps instructional materials within the domain of R&D information, categorizing them by structure and level of formalization. The heavy border, including the entries for noninstructional forms (documents and nondocuments), instructional forms, and references at the formal and the semiformal levels, indicates our view of the feasible boundaries of an R&D information collection. The very heavy border around the formal/instructional form

FIGURE I CLASSIFICATION OF RESOURCES BY LEVEL OF FORMALIZATION

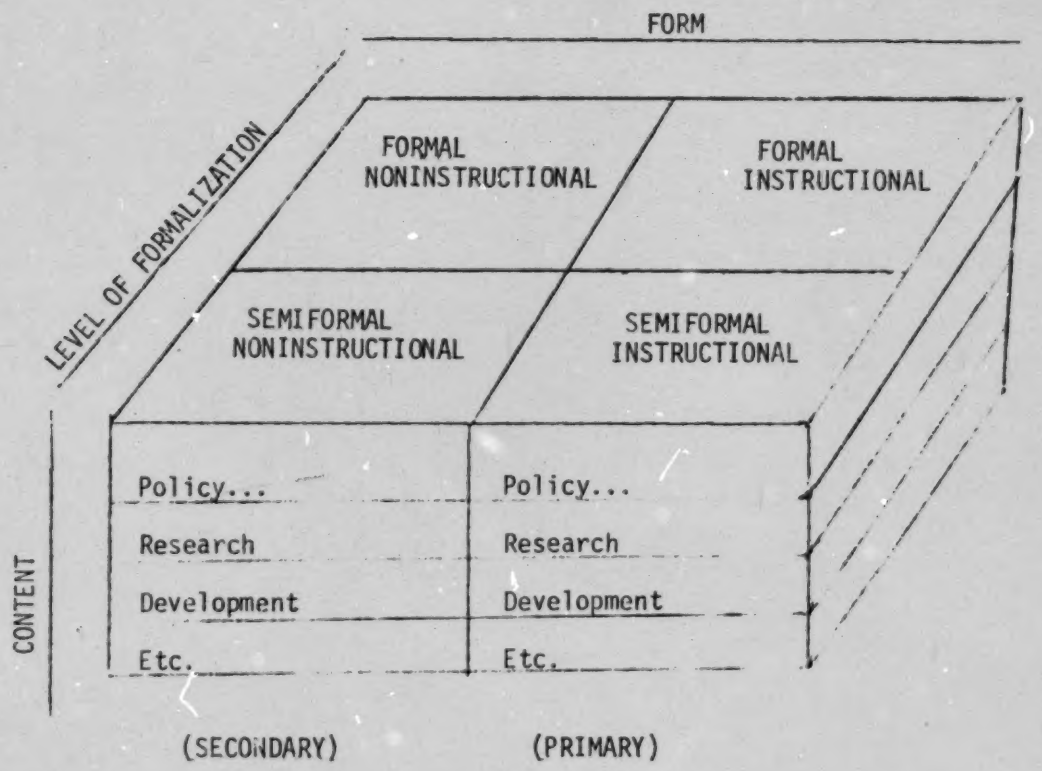
LEVEL	ORAL FORMS	NONINSTRUCTIONAL FORMS	INSTRUCTIONAL FORMS	REFERENCES
FORMAL	International National Regional meetings symposia conferences panels	Reviews, reprints, proceedings, preprints, journal articles, reference works, anthologies and collections, hard-cover books, soft-cover books, micro-forms, published audiovisual and other media materials	Published Materials: textbooks, workbooks, case studies, manuals, guides, tests, videotapes, films (slides, strips, movies), audio (records, tapes), displays, equipment, games, kits, computer software	Citation Services: meeting program abstracts abstract journals listing of manuscripts received current awareness book reviews Review Articles: collection synthesis Subject Bibliography: unannotated annotated evaluated Library Catalogues & Indexes
SEMI-FORMAL	Colloquia Seminars Special conferences Telephone conferences	Final reports, technical notes, technical memos, progress reports, technical reports, proposals, speeches, unpublished papers	Draft and test forms of any of the above instructional materials	References cited in journal articles, books, reports, theses Catalogues, advertisements, and publishers' materials Librarians Conference presentations Advertisements in journals
INFORMAL	Conversations Telephone calls Correspondence Casual meetings Unplanned encounters	Manuscripts, drafts, memos, correspondence, notes, outlines (document)	Treatments, outlines (I.M.), scripts, story boards, mock ups, renderings, flow charts, prototypes, sketches, designs, specifications	Journal contents & library book shelves Personal report team files Personal index files Conversations Correspondence Requested document distribution Unrequested document distribution Symposia Local meetings

cell indicates the probable boundary for an instructional materials collection. If an unusual effort were made, it might be possible to locate and acquire semiformal instructional forms. The dotted line within the semiformal/ instructional form cell identifies the possible extension.

Content as a Third Classification. Figure 2 introduces content as the third classification dimension in a schematic way. Note that we have simplified the scheme suggested by Figure 1 by omitting all oral forms and reference forms, and by deleting the entire informal level of formalization. This matrix, relating content, form, and level of formalization, was used in considering the problem of quantitatively estimating both absolute and relative numbers of primary and secondary instructional materials. If an adequate sampling frame existed it would be a relatively straightforward task of first classifying each item (thereby assigning it to one of the cells in Figure 2), then enumerating items within cells and by rows, columns, and blocks. However, nothing approaching an adequate sampling frame now exists. Although we have now perused descriptions of over 1500 instructional materials, and literally tens of thousands of titles of books, serials, etc., we have not found, nor have we been able to create, a collection whose composition is not susceptible to criticism. Despite these problems, we persisted in estimating the content of the R&D domain. The following section describes the approach and the results.

FIGURE 2

MATRIX: CONTENT BY STRUCTURE BY LEVEL



III. ESTIMATION OF AMOUNT OF TRAINING RESOURCE BY CONTENT CATEGORIES

A. Three Data Bases

In attempting to compare content of various information bases, ERIC, Books in Print, and three different instructional materials collections were examined. This led to the conception of a two-dimensional matrix (Figure 3) in which levels of formalization have been collapsed. The content of instructional materials was estimated by using two information bases: Subject Guide to Books in Print, 1972, and three instructional materials files (Guba and Gephart, 1970; Houston, 1973; and the Far West Laboratory's collection). Content for noninstructional materials was estimated by the ERIC collection.*

There are marked differences in the sizes of these bases. The ERIC collection, in December, 1972, included over 128,000 items, nearly evenly divided between journal article references in the Current Index to Journals in Education (CIJE) and references to reports and other documents in Research in Education (RIE). The Subject Guide to Books in Print, 1972, lists over 265,000 titles. But we have only slightly more than 1500 references to non-book instructional materials. A somewhat different picture emerges when we estimate the number of items "relevant" to educational R&D personnel and training content in each base. There is roughly an order of magnitude difference in the estimated size of the "R&D collections"; namely over 45,000 items in ERIC, over 6,000 books, and over 700 nonbook instructional materials. The bases for these estimates will be discussed later.

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* Two other data bases were examined and rejected. Paperbound Books in Print does list some titles not found in the Subject Guide to Books in Print, however, the majority of the titles are duplicated. A variety of indexes and catalogues (e.g., the NICEM Indexes and the Westinghouse Learning Directory) were also examined. The proportion of possibly relevant items was found to be so tiny, and our decisions based on listed information were judged to be so unreliable that searches using these resources were abandoned in favor of using the Houston, Guba and Gephart, and Far West collections.

FIGURE 3

MATRIX: CONTENT BY INFORMATION BASE

	NONINSTRUCTIONAL MATERIALS	INSTRUCTIONAL MATERIALS	
CONTENT	ERIC	BOOKS	NONBOOK
Policy...	#	#	#
Research	#	#	#
Development	#	#	#
Etc.			
Estimated R&D Collection	>45,000	> 6,000	> 700
Total Size of Base	>128,000	>265,000	>1500

Note: # indicates number to be estimated.

us approximately 35 percent of ERIC and 48 percent of the "other" instructional materials collections were judged to be relevant for a very broadly-defined conception of educational R&D personnel and training needs. Given the nature of these two bases, these relatively high percentages are not surprising. Neither is it surprising that only slightly over two percent of the titles in Books in Print should be considered relevant.

To estimate the number and content of actual instructional materials, only the Books in Print and the nonbook instructional materials collections are needed. We believe that comparison to the ERIC collection, while not providing direct information on instructional materials per se is useful for two reasons. First, ERIC lists recent documentary activity--the eventual "raw material" for textbooks and instructional materials. Second, our information regarding the content of the ERIC base is decidedly more comprehensive and reliable than for the other two bases. The ERIC data thus provides a useful comparison. Our general objective was to first place data in the cells of a matrix such as Figure 3, and then to compare the three bases.

Although the task of obtaining the data seemed feasible, it turned out to be a major effort requiring a number of arbitrary decisions and several "shortcuts" to obtain usable data at a reasonable cost. Before examining actual figures, it may be wise to recount the major difficulties. (Details are presented in Appendices B, C, and D.)

D. Estimate for ERIC

Lockheed Information Sciences of Palo Alto, California, provided us with computer-generated frequency counts of ERIC descriptor usage based on RIE documents ED001001 to ED066200 and EJ000001 to EJ062751.

This Lockheed Information Science's list contained over 5,000 descriptors. We selected 379 of these which are conceivably relevant to educational R&D personnel and training needs. The descriptors were organized into 14 major categories and were grouped in three clusters. (See Table 1.) The descriptors and the ERIC usage counts are provided in Appendix B.

TABLE 1

FREQUENCY AND RELATIVE USE OF CLASSES OF DESCRIPTOR TERMS RELATING TO EDUCATIONAL RDD&E PERSONNEL AND TRAINING TOPICS IN RIE/CIJE (DECEMBER 1972)

Topics	No. of Terms	Frequency of Use (Thousands)	Percentage
Policy, Planning, Change, Innovation	(16)	15.1	8.2
Research	(34)	18.2	9.8
Design and Development	(17)	12.9	7.0
Dissemination and Communication	(10)	4.3	2.3
Evaluation	(21)	15.0	8.1
******			[35.4]
Science and Technology	(8)	2.8	1.5
Data Analysis, Statistics, Other Analyses	(32)	11.3	6.1
Objectives and Criteria	(11)	3.7	2.0
Tests, Measurement, Data Collection Instruments.	(66)	26.7	14.4
Methodology, Technique, Theory	(47)	30.3	16.4
******			[40.4]
Disciplines and Specialties	(9)	2.4	1.3
Skills, Training, Professional Education	(28)	11.5	6.2
Personnel	(44)	10.3	5.6
Content and Media	(36)	20.4	11.0
			[24.1]
Total	379	184.9	99.9

The entries in Table 1 can be read this way: Sixteen descriptors, classed under the heading, "Policy, Planning, Change, and Innovation" were selected. These 16 descriptors were used 15.1 thousand times--8.2 percent of the total use of the 379 descriptors listed in Appendix B. We have, in effect, "adopted" the ERIC Thesaurus of Descriptors as our basis for content classification and have selected the 379 descriptors listed in Appendix B as our "operational definition" of educational R&D training content, as defined by the ERIC descriptors. This "definition" is totally arbitrary and based solely on the author's judgment. Appendix B must be examined to understand what was considered.

Given these descriptor counts, we needed to estimate the number of documents represented. Since the ERIC descriptors index "information" within documents, and since several kinds of information, each calling for a different descriptor, is contained in the same document, the number of documents represented must be substantially smaller than the descriptor usage counts. Our next problem was to find a way to convert usage counts to estimates of document counts. Appendix C describes our estimation method which resulted in an estimate that the ERIC collection (as of December, 1972) contained at least 45,000 items to which the descriptors listed in Appendix B have been applied.

The first cluster "Policy..., Research, Design and Development and Evaluation," which may be considered the R&D content "core," is estimated to include 16,000 to 26,000 ERIC documents with slightly more than half in RIE and slightly less than half in CIJE. The RIE collection dates back to 1966 and CIJE, to 1969. Since CIJE started later and currently indexes nearly one and a half times as many items as RIE, the ratio between RIE documents and CIJE documents may change substantially in the next few years.

If a reasonably comprehensive, retrospective search (1964-1973) were made of published materials (including all ERIC documents) pertinent to only this "Policy...RDD&E" set, the number of related documents (e.g., those on statistics, measurement, methodology, personnel, content and media, etc.) would be proportionally larger.

This very large number of items which could be included in an educational RDD&E personnel and training document collection reminds us of Paisley's dictum (Hood, et al., September, 1972, p. 86) that the information center should exist to disseminate information, not archive it, and that its collection should reflect users' needs, not the size of the knowledge base.

To summarize, our estimation of journals and other documents, which may be considered as potential instructional materials or as a knowledge base for instructional materials, has been based entirely on ERIC, primarily because the base is large, its content descriptor system has been carefully developed, and statistics regarding its content are available. The possible flaws in the ERIC estimates are that the collection is recent and ERIC does not provide much information on commerical publications, like books.

Most of the materials in ERIC can be located in Figure 1 in the cells for formal of semiformal noninstructional forms. The ERIC collection analysis, because it is based on over 128,000 documents, with at least 45,000 of these relevant to RDD&E personnel and training topics, affords a useful and moderately reliable "yardstick" against which we may judge the results of our subsequent examination of instructional materials based on Books in Print and on the Guba and Gephart, the Houston, and the Far West Laboratory files.

Unfortunately, there is no comparable, direct basis for estimating informal or unreferenced semiformal materials comparable to the ERIC content. We assume that these less formal items have roughly the same relative frequencies for content. Obviously, the absolute number of informal and semiformal documents will be many times the number of formal documents.

C. Estimates for Books in Print

Naturally, published textbooks and other professional books may serve directly as instructional resources. We used Bowker's Subject Guide to Books in Print, 1972, which includes approximately 265,000 titles, as our base for estimating the number of pertinent books. In seeking relevant subject headings, 1826 pages had to be manually scanned and each title within a selected subject heading had to be inspected. This is a considerably more fallible analysis than was performed with RIE and CIJE, which are relatively thoroughly indexed. Approximately six descriptors are applied to the average "RDD&E" CIJE document and nine and one-half descriptors to the RIE document. By contrast, 265,000 books appear only 392,000 times (slightly less than one and a half times per book) in the Subject Guide to Books in Print. Moreover, the initial Bowker classification, and certainly our own classification, has been based primarily on the book title. Since not every entry on every page was read, undoubtedly many items which appeared under unusual subject headings have been missed. On the other hand, the counts have been "generous" but selective; nearly every book which seemed to bear on RDD&E or personnel and training content was counted, although not all books in a category were counted. For instance, under the "Disciplines and Specialties" category, 18 out of over 800 titles in "Economics" and 10 out of 42 titles in "Psychology--Experimental" were counted. Unlike the RIE/CIJE data, these are not computer-derived frequencies or descriptors, but only rough, highly

subjective judgments of whether books in selected subject listings should be considered as relevant or valuable.

Although the ERIC descriptors and the Books in Print subject headings are often quite different, an attempt has been made to summarize the results under the same major subject headings used in Table 1. The data for Books in Print are displayed in Table 2.

TABLE 2

NUMBER OF TITLES IN BOOKS IN PRINT, 1972,
RELATING TO EDUCATIONAL RDD&E PERSONNEL AND TRAINING TOPICS

Topics	No. of Titles	Per-cent
Policy, Planning, Change, Innovation	738	10.7
Research	791	11.5
Design and Development	82	1.2
Dissemination and Communication	316	4.6
Evaluation	109	1.6
******		
Science and Technology	49	0.7
Data Analysis, Statistics, Other Analyses . .	1127	16.4
Objectives and Criteria	147	2.1
Tests, Measurement, Data Collection Instruments	617	9.0
Methodology, Technique, Theory	1406	20.4
*******		
Disciplines and Specialities	614	8.9
Skills, Training, Professional Education . . .	169	2.5
Personnel	280	4.1
Content and Media	435	6.3
Total	6880	100.0

Nearly seven thousand titles were found, with over 2,000 titles in the first "Policy...RDD&E" cluster. The great majority of these titles deal with "Policy, Planning, Change, Innovation," "Research," "Dissemination and Communication." Markedly underrepresented are books in "Evaluation" and in "Design and Development" (which excludes instructional technology, programmed instruction titles that appear under "Content and Media"). Looking for Design and Development"

or "Evaluation" books in Books in Print proved to be like looking for the proverbial needle in a haystack. The Books in Print subject headings are not at all helpful. For instance, the Stufflebeam, et al. PDK book on Educational Evaluation and Decision-Making was finally found under "School Management and Organization." The counts on "Evaluation" and "Design and Development" undoubtedly are underestimates, but are probably close.

While we found less than 200 books in the "Design and Development" and in the "Evaluation" categories, we found nearly eight hundred books in the "Research" category, over eleven hundred books in the "Data Analysis, Statistics, and other Analyses" category and over fourteen hundred books in the "Methodology, Technique, Theory" category.

D. Estimates for Nonbook Materials

We combined three sources to estimate nonbook instructional resources. Resources for Performance-Based Education (Houston, et al., 1973) lists and annotates over 1,100 instructional materials including films, slides, tapes, modules, programmed texts, and multimedia kits. The materials pertain primarily to training prospective and inservice education personnel. Specifically excluded are textbooks, materials produced prior to 1967, resources for children, materials (unless they are in modular format) whose purpose is to teach elementary or secondary subjects, descriptions of programs, and lists of objectives or competences.

Most of the materials are still being developed and many are undergoing revision. To compile their list, the authors had contacted performance-based education developers throughout the country, commercial publishers, R&D centers, educational laboratories, professional organizations, Teacher Corps projects, special education instructional materials centers, protocol training projects, university audiovisual centers and others concerned with development and resources.

Guba and Gephart (1970) had made an earlier search which focused more directly on collecting instructional materials used in teaching about research processes. After a notably unproductive literature search and an unrewarding effort to solicit materials through announcements in professional journals and newsletters, they turned to direct contacts through visits, meetings, and correspondence. These contacts netted 327 different items including textual materials, learning exercises, bibliographies, examinations, course descriptions, etc. Virtually all of these materials could be classified as semiformal, although a few have since emerged in formal publications.

The Far West Laboratory collection of instructional materials focuses primarily on educational development, diffusion, and evaluation, applied research, and educational policy, planning and management. Excluding published textbooks, it contains approximately one hundred additional items.

The Far West collection was assembled in a number of ways including contacting R&D training materials developers, monitoring the CEDaR catalogues and other instructional materials catalogues.

Taken together, these three sources list approximately 1500 different items. As in the case of our search of Books in Print, our counts for these other instructional materials were made manually. However, in this instance we worked from annotations rather than from titles only. Our counts are displayed in Table 3.

TABLE 3

NUMBER OF NONBOOK INSTRUCTIONAL MATERIALS
RELATING TO EDUCATIONAL RDD&E PERSONNEL AND TRAINING TOPICS

Topics	Count	Percent
Policy, Planning, Change, Innovation	79	10.7
Research	71	9.6
Design and Development	44	6.0
Dissemination and Communication	29	3.9
Evaluation	40	5.4
******		
Science and Technology	5	0.7
Data Analysis, Statistics, Other Analyses	139	18.9
Objectives and Criteria	62	8.4
Tests, Measurement, Data Collection Instruments	65	8.8
Methodology, Technique, Theory	79	10.7
******		
Disciplines and Specialities	11	1.5
Skills, Training, Professional Education	28	3.8
Personnel	5	0.7
Content and Media	80	10.9
Total	737	100.0

E. Comparison of the Three Bases

We have noted in sections B, C, and D how we arrived at the counts listed in Tables 1, 2, and 3. These data are consolidated and compared in Table 4 on the following page; both the count and the percentage ratio of the count to its base is presented. The counts for books and for "other" instructional materials are counts of titles. The count for journals and other documents is an estimate derived by multiplying the ERIC descriptor percentages of Table 1 against an assumed base of 40,000 documents, each document to be assigned to only one of the 14 categories.

TABLE 4

COMPARISON OF CONTENT COUNTS IN THREE INFORMATION BASES

Subject Content Category	Instructional Materials Nonbooks		Instructional Materials Books		ERIC Journals & Other Documents	
	No.	Percent	No.	Percent	No.	Percent
1. Policy, Planning, Change, Innovation	79	10.7	738	10.7	3280	8.2
2. Research	71	9.6	791	11.5	3920	9.8
3. Design and Development	44	6.0	82	1.2	2800	7.0
4. Dissemination and Communication	29	3.9	316	4.6	920	2.3
5. Evaluation	40	5.4	109	1.6	3240	8.1
Subtotal	263	35.6	2036	29.6	14160	35.4
6. Science and Technology	5	0.7	49	0.7	600	1.5
7. Data Analysis, Statistics, Other Analyses	139	18.9	1127	16.4	2440	6.1
8. Objectives and Criteria	62	8.4	147	2.1	800	2.0
9. Tests, Measurement, Data Collection Instruments	65	8.8	617	9.0	5760	14.4
10. Methodology, Technique, Theory	79	10.7	1406	20.4	6560	16.4
Subtotal	350	47.5	3346	48.6	16160	40.4
11. Disciplines and Specialties	11	1.5	614	8.9	520	1.3
12. Skills, Training, Professional Education	28	3.8	169	2.5	2480	6.2
13. Personnel	5	0.7	280	4.1	2240	5.6
14. Content and Media	80	10.9	435	6.3	4400	11.0
Subtotal	124	16.9	1498	21.8	9640	24.1
Total	737	100.0	6880	100.0	39960	99.9

Counts of this order for ERIC-like documents might be encountered in a retrospective search of the U.S. educational literature for, say, only the past five years. If the search were to include a longer period or the literature of other countries, the counts would be considerably higher and proportions among content categories might change.

Table 4 suggests there is a rough "order of magnitude" difference in counts with approximately ten books and fifty to sixty journal articles and other documents for every one nonbook instructional material. (If a larger journal and another document base were assumed, e.g., a ten-year retrospective search, the ratios would approach 1:10:100.)

Fixing on the top cluster in Table 4, the "Policy...RDD&E" cluster, we find counts of 263 nonbook instructional materials, 2036 books, and an estimate of at least 14,160 journal articles. For this cluster the percentage for nonbook instructional materials are quite similar to the percentages for journals and other documents. By comparison, the percentage for books in the "Evaluation" and in "Design and Development" categories are markedly smaller. Our interpretation is that "Evaluation" and "Design and Development" are relatively new areas not yet well-represented in "hard-cover" literature. The nonbook instructional materials collections contain a large proportion of semiformal instructional materials, which, like the ERIC documents, are more reflective of recent activity.

The second cluster, "Science, Data, Objectives, Tests, Methodology," provides much of the "disciplined inquiry" technical content for the disciplines of the previous cluster. The counts are similar, although a little higher: 350 nonbook instructional materials, 3,346 books, over 16,160 journal articles and other documents. The "Methodology Technique and Theory" category and the "Data Analysis, Statistics, Other Analyses"

categories are the two major contributors. Taken together they account for over 2500 books and 200 other instructional materials. The disproportionally higher percentage of nonbook instructional materials in the "Objectives and Criteria" category is explained primarily by the large number of "behavioral objectives" modules listed in Resources for Performance-Based Education.

The reader is urged to examine the three figures in Appendix A at this point. They present the scatter diagrams relating counts of instructional materials, ERIC descriptors, and book titles. The data have been plotted on log-log paper to make the counts more manageable. Lines of best fit are also displayed together with their regression equations. Points which are far off the regression lines indicate content categories which are not well predicted. For instance, in Figure A1, "Data Analysis, Statistics and Other Analyses" (7) and "Objectives and Criteria" (8) are above the lines, indicating that there are many more (nonbook) instructional materials than would be expected from the ERIC descriptor counts. Conversely, "Personnel" (13) plots far below the line, indicating far fewer instructional materials than would be expected from the ERIC descriptor counts.

Figure A2, relating instructional materials to book titles, shows that "Design and Development" (3) and "Objectives and Criteria" (8) are farthest above the line of best fit, indicating more nonbook instructional materials than would be predicted from the count of book titles. "Personnel" (13) is very much below the line of best fit, indicating far fewer instructional materials than would be suggested than the book count. (The author was surprised to find any instructional materials in this content category.)

Figure A3, relating book titles to ERIC descriptors, shows there are far more book titles in the "Data Analysis, Statistics, and Other Analyses" category (7) than would be expected from the ERIC descriptor count.

Figure 3 can be used to illustrate the difference in the two lines of best fit. The line of best fit for books predicted from ERIC counts is the line with the lower slope (it intercepts the vertical book title axis at about 52 books, for 1,000 ERIC descriptors). The "Data Analysis, Statistics, Other Analyses" (7) point is the point farthest above this line. But, the line of best fit in predicting ERIC descriptor counts from book title counts is the steeper line. (It intercepts the horizontal ERIC descriptor axis at about 1,900 descriptors, for 10 book titles). On this line it is point 11 ("Disciplines and Specialities") not 7, which is the point farthest above this line, indicating there are markedly fewer ERIC descriptors in the "Disciplines and Specialities" areas than were expected given the number of book titles. Note that points 3 ("Design and Development") and 5 ("Evaluation") fall below both lines of best fit indicating relatively more ERIC descriptors than book titles, no matter which is used as the predictor.

Possibly remarkable is the fact that the correlations among these three sets of counts are quite comparable: .60 for instructional materials and ERIC descriptors; .61 for instructional materials and book titles, and .62 for book titles and ERIC descriptors. Given the grossness of our categories and the difficulties we experienced in equating content classifications, we were surprised that the correlations would be this high. All three correlations are significant, although the coefficiencts of alienation are high (≅.80, compared to a zero correlation) the error of estimate is reduced by only about 20 percent. Although there is a significant relation among the three sets of count, the relationships are far from perfect.

Note that the high count categories, 1. "Policy, Planning, Change and

Innovation", 2. "Research" and 9. "Tests, Measurement, and Data Collection Instruments" are near the diagonal lines of best fit on all three figures. These three content categories are reasonably well predicted from any of the three information bases.

If our interest is focused on predicting the quantities of nonbook instructional materials, we note from figure A1 that the following are the categories best predicted by ERIC descriptors (those located closest to less steep lines of best fit): 1. Policy, Planning, Change, Innovation, 2. Research, 3. Design and Development, 4. Dissemination and Communication, 5. Evaluation, 9. Tests, Measurements, Data Collection Instruments, 10. Methodology, Technique and Theory, 11. Disciplines and Specialties, 12. Skills, Training and Professional Education, and 14. Content and Media. This is a remarkably large number of categories. What is not predicted well (points located farther from the line of best fit) are the four categories: 6. Science and Technology, 7. Data Analysis, Statistics, Other Analyses, 8. Objectives and Criteria, and 13. Personnel.

Turning to figure A2 we note that, in general, book title counts are much less effective predictors of nonbook instructional materials. The following content categories lie closest to the line of best fit: 1. Policy, Planning, Change, Innovation, 2. Research, 4. Dissemination and Communication, 9. Tests, Measurement and Data Collection Instruments, 10. Methodology, Technique and Theory, and 12. Skills, Training and Professional Education. Not predicted as well from book titles are the content categories: 3. Design and Development, 5. Evaluation, 6. Science and Technology, 7. Data Analysis, Statistics and Other Analyses, 8. Objectives and Criteria, 11. Disciplines and Specialties, 13. Personnel, and 14. Content and Media.

In Table 5 we have extracted the count data from Table 4 for only eleven content categories* for the two instructional materials bases, books and nonbooks. Entries are displayed in descending order based on book counts.

The reader may note that the counts for nonbook and book instructional materials are of roughly similar rank orders (the rank order correlation is .81). Table 5 is a simple matrix relating the dimensions of content and format. The data counts are undoubtedly underestimates; and could be raised by more diligent search; however, the gross proportionalities among counts would probably remain quite similar. Note that the top five content categories account for 80 percent of the books and 62 percent of the nonbooks. These are well-established, traditional, educational research areas. By contrast the three areas of "Dissemination and Communication," "Evaluation," and "Design and Development" account for less than nine percent of the books and only sixteen percent of the nonbook instructional materials.

TABLE 5

COUNTS FOR ELEVEN R&D SUBJECT MATTER CONTENT CATEGORIES
FOR BOOK AND NONBOOK INSTRUCTIONAL MATERIALS

Content Category	Nonbooks		Books	
	Count	Percent	Count	Percent
Methodology, Technique, Theory	79	11.4	1406	24.2
Data Analysis, Statistics, Other Analyses	139	20.0	1127	19.4
Research	71	10.2	791	13.6
Policy, Planning, Change, Innovation	79	11.4	738	12.7
Tests, Measurement, Data Collection Instru.	65	9.4	617	10.6
Content and Media	80	11.5	437	7.5
Dissemination and Communication	29	4.2	316	5.4
Objectives and Criteria	62	8.9	147	2.5
Evaluation	40	5.8	109	1.9
Design and Development	44	6.3	82	1.4
Science and Technology	5	0.7	49	0.8
Totals	693	99.8	5819	100.0

* The three categories: "Disciplines and Specialties," "Skills, Training, Professional Education," and "Personnel" have been omitted because they are not of direct interest for instructional content. They are of interest for personnel and training information.

F. Other Dimensions

The previous sections have focused primarily on attempts to provide quantitative estimates of R&D subject content by major formats, notably ERIC documents, books and nonbook instructional materials.

When we consider format and level of formalization, we immediately note that all of the books are at the formal level. This is not true for instructional materials. We turned to Resources for Performance-Based Education (Houston, et al., 1973) to obtain estimates for specific formats and levels of formalization.* Regarding formats, we found the results shown on Table 6.

TABLE 6

FORMATS OF R&D RELEVANT TITLES IN PERFORMANCE-BASED EDUCATION

Format	No.	Percent
Instructional modules	134	42.3
Kits, multimedia packages.	59	18.6
Films and film books	47	14.8
Slides, tapes and filmstrips	44	13.9
Videotapes	12	3.8
Audio tapes	8	2.5
Programmed texts	7	2.2
Games and Simulations	6	1.9
Total	317	100.0

We note that 61 percent of these items are priced, and only 39 percent are marked "consult distributor." We have taken this as a rough indication of availability, and have assumed that the nearly 200 priced items are "formal" and that the 123 items marked "consult distributor" are still in the "semiformal" category.

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*The Guba and Gephart base consists entirely of semiformal materials. Their Table 1 (Guba and Gephart, 1970, p. 35) indicates that 87 percent of the 327 items were either textual materials or written learning exercises.

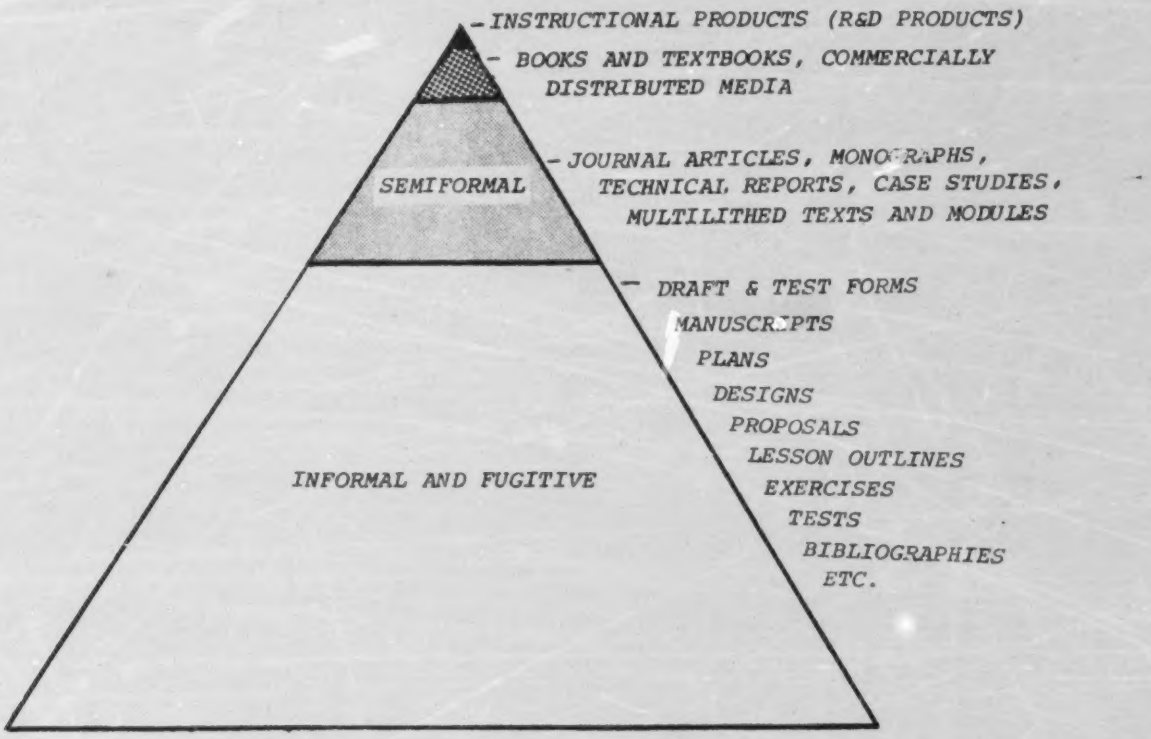
G. Summary

This report has attempted to examine the content and structure of the domain of R&D training resources. It began by locating instructional materials within a larger matrix which classified R&D resources by structure and levels of formalization.

Examination of ERIC, Books in Print and three nonbook instructional materials collections indicated there is roughly an "order of magnitude" ratio for the estimated quantities in these three bases. By using these ratios (Figure 4), we made a graphic display in which the sizes of the areas on the figure indicates the estimated relative sizes of educational R&D instructional resources. This figure suggests that 90 percent of the R&D instructional resources are largely informal and fugitive.

FIGURE 4

ESTIMATED RELATIVE PROPORTIONS OF EDUCATIONAL R&D INSTRUCTIONAL MATERIALS BY LEVEL OF FORMALIZATION



Many of the materials at this level are developed for the use of individual instructors. Generally they are not published, refereed, or referenced. Perhaps 10 percent find their way into the semiformal level where they may appear in a journal article, monograph, or limited edition of a module of film. The item may be referenced in ERIC or in compendia such as Resources for Performance-Based Education. Marketable items at this level may find a commercial publisher, but most are destined for "thin-market" distribution.

Possibly one or two percent achieve "hard-cover" commercial publication status, and well over 95 percent of the materials at this level appear in print format. We estimate that only a small fraction of one percent of all the R&D resources are themselves subjected to the R&D cycle (development, field test, revision) before release for publication. Given the data presented in Table 6, there is reason to believe that a substantial proportion of the "R&D cycle" instructional materials will appear as printed "modules" or in some media form.

Generally, "accessibility" and "quality" will be related to the vertical dimension of Figure 4. The higher areas are subjected to greater external review, editing, commercial publication and marketing, and ultimately to R&D testing. As they pass these "quality" screens, they tend to become more physically accessible and easier to locate in catalogues and indexes.

Our studies suggest that the number of fully developed and tested educational R&D instructional materials must be much less than 100 items. There are perhaps as many as 1,000 items which have undergone minimal development, but have probably been subject to only informal testing or evaluation. After actually counting 6880 book titles, we estimate that possibly 10,000 books and textbooks exist which have reasonably direct bearing on R&D content

as we have defined it. We have no way of directly estimating the size of the informal and fugitive base in Figure 4. It is certainly very large and many times the number of books and textbooks.

These figures suggest there is a large amount of relevant material. In a sense there is, but this is true partly because educational R&D training content is so broadly based. As Table 5 shows, well over half of the content of our book counts is contained in these three major categories: 10. Methodology, Technique and Theory; 7. Data Analysis, Statistics, Other Analyses and 9. Tests, Measurement, and Data Collection Instruments. Much of this content is derived from, and shared with, behaviorial and social science.

By contrast only 3.3 percent of the book titles fall in the "Design and Development" or "Evaluation" categories. We were able to locate less than 200 books and other instructional materials in either of these categories.

When we examine data by time periods, it appears that possibly the most accessible and established, but least timely, instructional materials resources are books. It usually requires time to develop a discipline or subject content area to the stage where it is well represented by books and textbooks. Yet the contents of ERIC, represented by reports collected since 1966 and journal articles cited since 1969, are more reflective of recent R&D activity. We made the assumption that ERIC data may thus better reflect potential "raw" instructional materials resources. The lines of best fit (Appendix A, Figures A1 and A2) seem to confirm this assumption. Hence despite the preponderance of book titles in the more classical "educational research" content areas, it is also useful to note (see Table 5) that the percentages of nonbook instructional materials are markedly larger than the percentages for books in the areas of "Evaluation" and "Design and Develop-

ment." The last part of Appendix C displays time trend data which suggests that the content and character of the domain of educational R&D information, at least as indexed by ERIC, is shifting. Because of the very large base in well-established R&D areas, these changes are relatively small, but nevertheless, quite apparent.

We regret that time and resources have not permitted a more detailed examination of the domain of R&D training resources. Classification by intended target audience, level of difficulty, estimated quality, etc., is possible, but is well beyond the time and resources of this project.

What we have succeeded in doing is to go beyond complete guesswork by analyzing and comparing several large information bases in order to arrive at data-based estimates regarding subject content for various formats, including books, nonbook instructional materials, and ERIC documents. Appendices B and D may also be helpful in indicating where to look and how much one may find with respect to several hundred specific subject headings.

We hope that this report has helped to sketch out the rough outlines of the actual quantities and proportions of what may be found.

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Guba, E. G., and Gephart, W. J. Training materials for research, development and diffusion training programs. Final Report. 1970. Project No. 7-1018, Grant No. OE-1-7-071018-4501, U. S. Department of Health, Education, and Welfare, Office of Education, National Center for Educational Research and Development.

Hood, P. D. Evaluation of Instructional Materials for Educational RDD&T Content Areas. San Francisco: Far West Laboratory for Educational Research and Development, July 1973.

Hood, P. D., et al. Design of a Personnel and Training Information System for Educational R+D Personnel: Report of the Planning Phase. Interim Report, September, 1972, Project No. RO29047, Contract No. OEC-0-72-5310, U. S. Department of Health, Education and Welfare. San Francisco: Far West Laboratory for Educational Research and Development, September, 1972.

Houston, W. R., et al. Resources for Performance-Based Education. Albany, New York: The University of the State of New York, The State Education Department, Division of Teacher Education and Certification, March, 1973.

Subject Guide to Books in Print. New York: R. R. Bowker Company, 1972.

APPENDIX A

SCATTERGRAMS OF COUNTS FOR R&D CONTENT

Figures A-1, A-2 and A-3 present the scatter diagrams and correlations between logarithms of counts for instructional materials, book titles, and ERIC descriptors. Logarithmic transformations have been employed to reduce the data to manageable configurations.*

The formulas for the lines of best fit are:

Figure A-1

log nr. of instructional materials = -1.467 + .757 log nr. of ERIC descriptors

log nr. of ERIC descriptors = 3.267 + .472 log nr. of instructional materials

Figure A-2

log nr. of instructional materials = 0.013 + .617 log nr. of book titles

log nr. of book titles = 1.569 + .603 log nr. of instructional materials

Figure A-3

log nr. of book titles = -0.594 + .776 log nr. of ERIC descriptors

log nr. of ERIC descriptors = 2.763 + .494 log nr. of book titles

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* Forman S. Acton Analysis of Straight-line Data. New York: Dover Publications, 1959, p. 223. Professor Acton notes that data that are counts of populations, vital statistics, census data and the like are almost always improved by taking logs.

FIG. A1

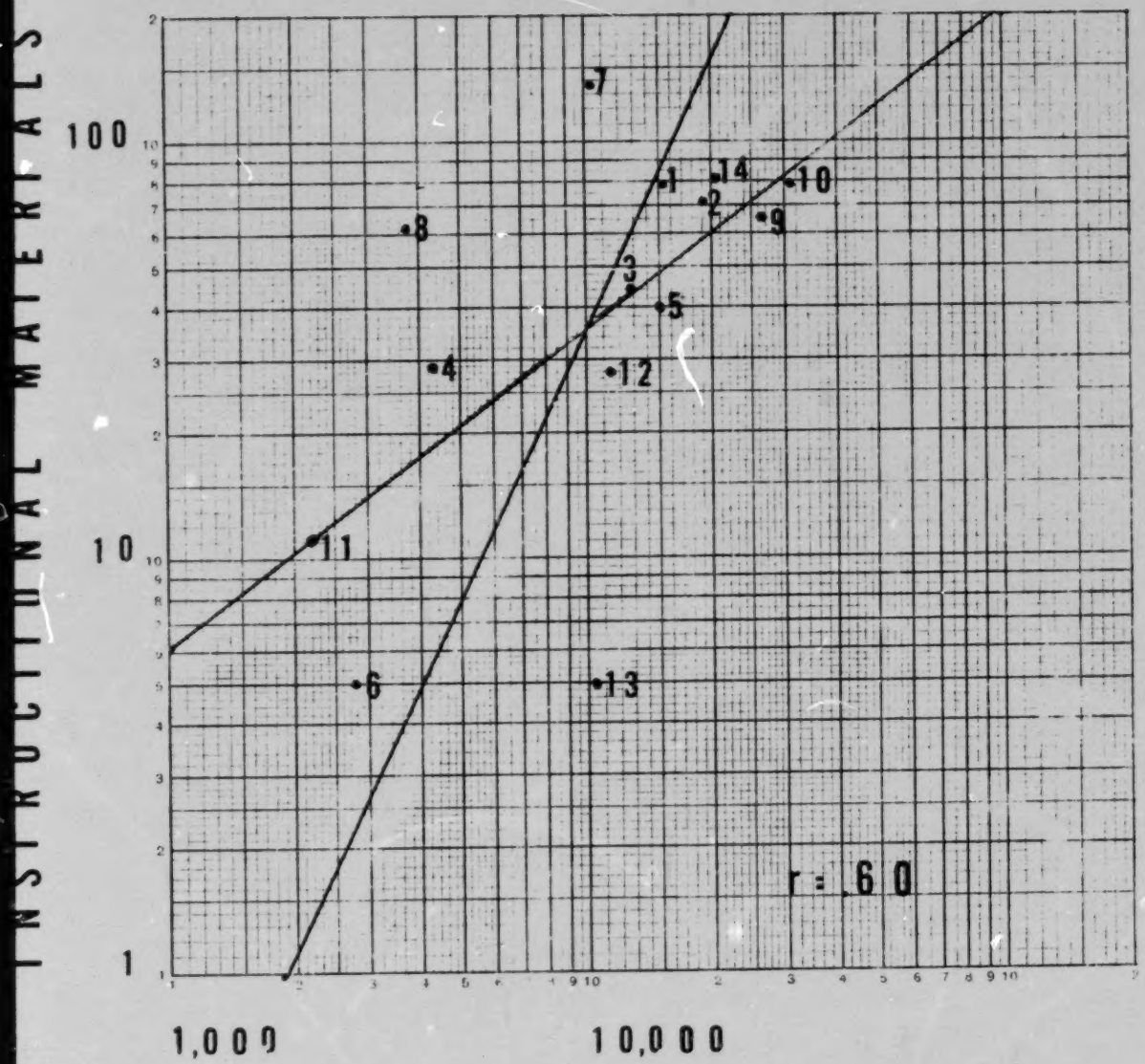

INSTRUCTIONAL MATERIALS
100
10
1
1,000
10,000
ERIC DESCRIPTORS
r = .60
1
2
3
4
5
6
7
8
9
10
11
12
13
14

FIG. A2

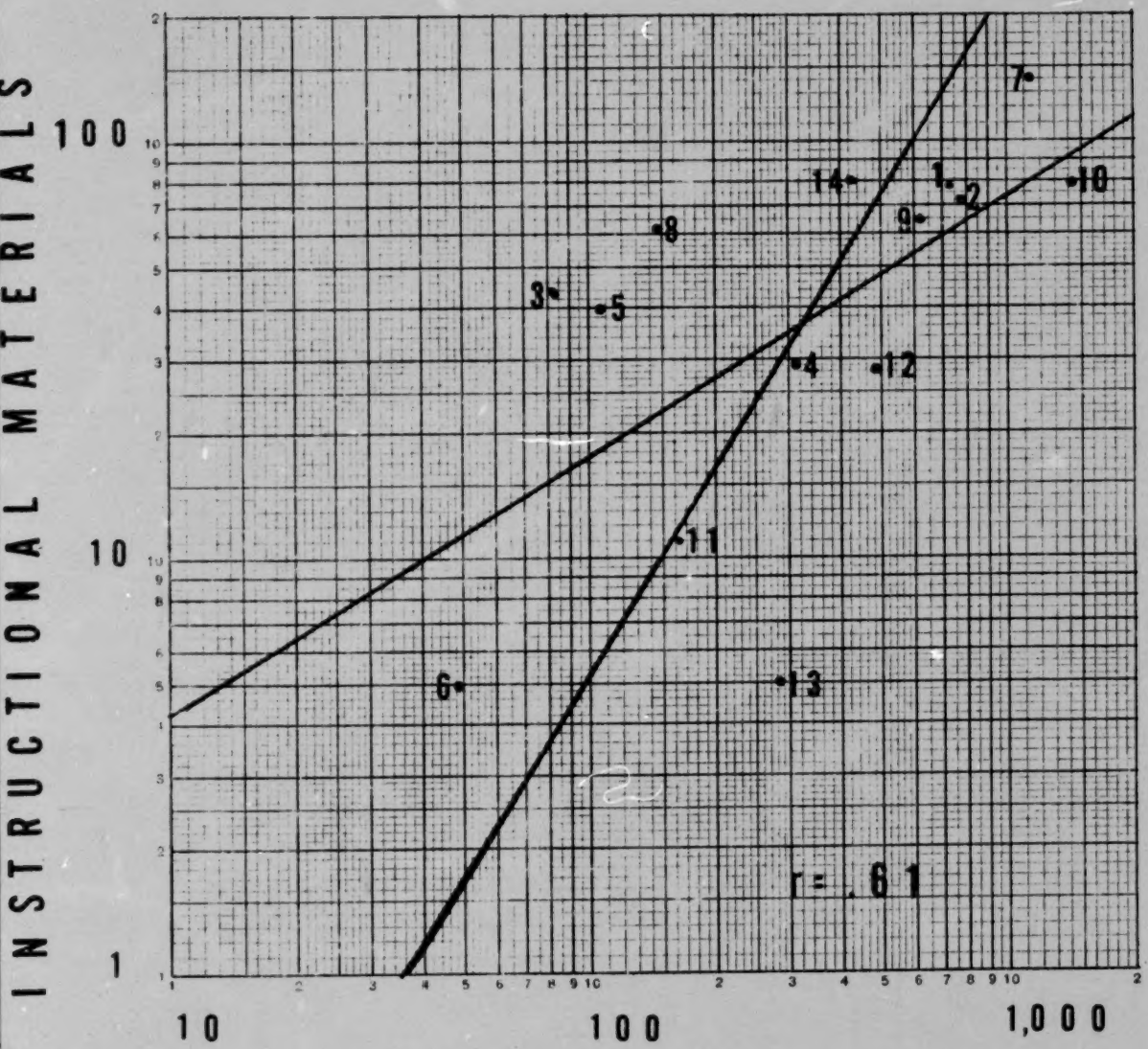
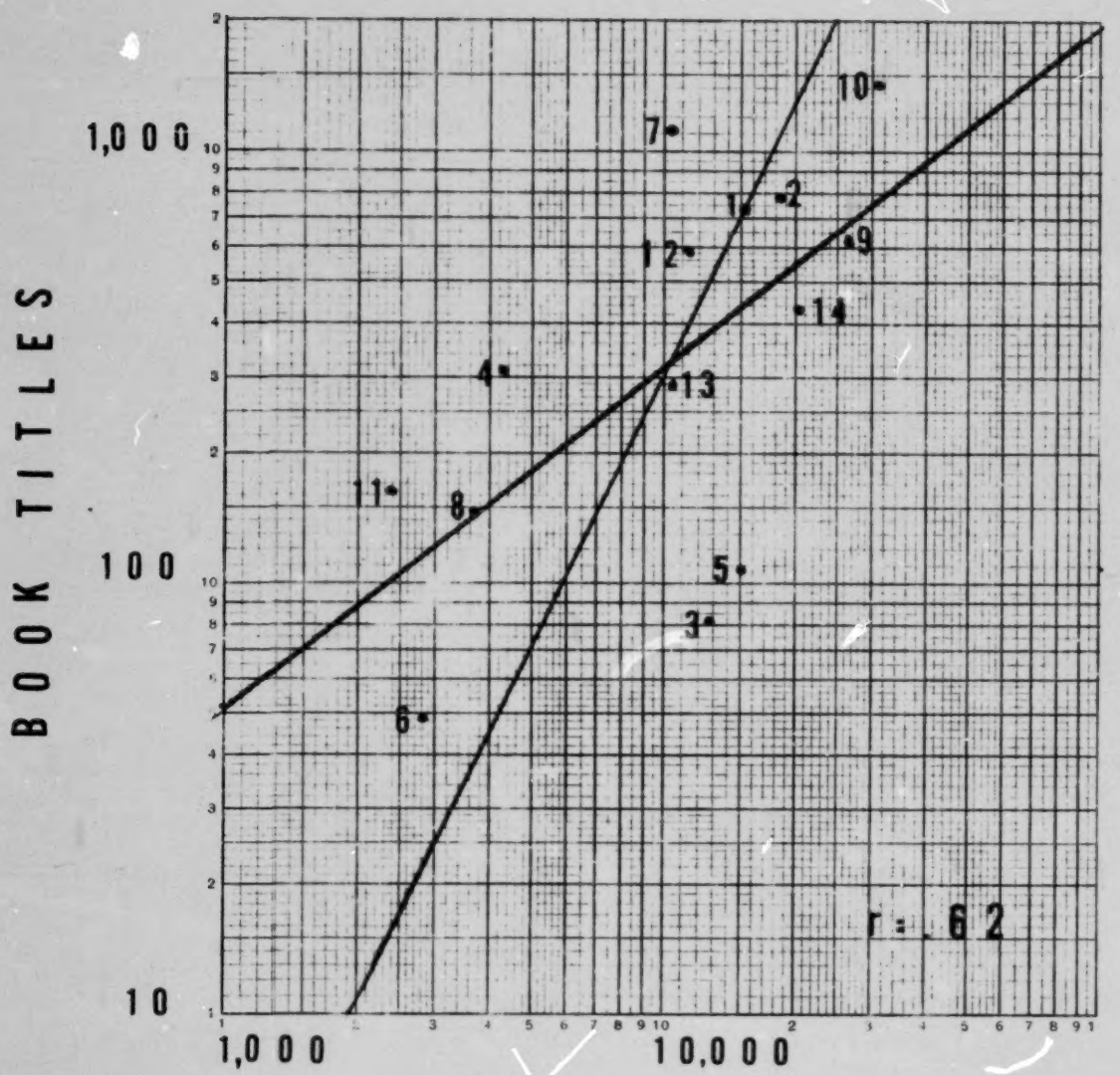

INSTRUCTIONAL MATERIALS
100
10
1
10
100
1,000
BOOK TITLES
r = .61
1
2
3
4
5
6
7
8
9
10
11
12
13
14

FIG. A3


BOOK TITLES
1,000
100
10
1,000
10,000
ERIC DESCRIPTORS
r = .62
1
2
3
4
5
6
7
8
9
10
11
12
13
14

APPENDIX B

LISTING OF DESCRIPTORS AND IDENTIFIERS AND THEIR FREQUENCY OF USE IN RIE/CIJE (TO DECEMBER 1972) [1]

Policy, Planning, Change and Innovation

896	Curriculum Planning
2627	Educational Change
(681)	Educational Development
2136	Educational Innovation
1901	Educational Planning
769	Educational Policy
336	Financial Policy
898	Instructional Innovation
44	Language Planning
18	Neighborhood School Policy
1009	Planning
223	Policy
569	Policy Formation
1773	Program Planning
262	Public Policy
1566	Social Change
96	Social Planning
15,123	
(15,804)	

[1] Source Lockheed Information Sciences, March, 1973. Numbers in parentheses indicate that the descriptor is counted in another category. Total without parens is for all descriptors in list without parens. Total in parens includes counts for descriptors in parens. Counts in brackets are not listed elsewhere. These counts are based on a total of 128 thousand RIE and CIJE documents.

Research

76	Action Research
35	Agricultural Research Projects
1648	Behavioral Science Research
193	Classroom Research
196	Creativity Research
401	Curriculum Research
180	Economic Research
3529	Educational Research
203	Environmental Research
181	Facility Utilization Research
44	Interest Research
1231	Language Research
137	Library Research
240	Media Research
182	Medical Research
168	Methods Research
206	Operations Research
44	Poverty Research
1230	Reading Research
3466	Research
435	Research and Development Centers
27	Research and Instruction Units
54	Research Committees
(168)	Research Coordinating Units
168	Research Criteria
456	Research Designs
24	Research Directors
91	Research Libraries
(1684)	Research Methodology
864	Research Needs
149	Research Opportunities
520	Research Problems
123	Research Proposals
1232	Research Reviews
(131)	Research Skills
(181)	Research Tools
(358)	Research Utilization
(181)	Researchers
452	Scientific Research
45	Textbook Research
18,230	
(20,933)	

Design & Development

950	Curriculum Design
4961	Curriculum Development
216	Design
307	Design Needs
69	Design Preferences
223	Development
681	Educational Development
385	Instructional Design
292	Film Production
580	Materials Development
379	Program Design
2064	Program Development
55	Psychological Design Needs
1052	Systems Approach
275	Systems Development
290	Teacher Developed Materials
83	Textbook Preparation

12,862

Dissemination

348	Information Center
1212	Information Dissemination
441	Information Needs
279	Information Networks
177	Information Seeking
537	Information Services
423	Information Utilization
168	Research Coordinating Units
358	Research Utilization
(107)	Technical Reports
391	Use Studies
4,334	
(4,441)	

Evaluation

81	Administrator Evaluation
130	Counselor Evaluation
357	Course Evaluation
(208)	Criteria
884	Curriculum Evaluation
1394	Evaluation Criteria
1084	Evaluation Methods
212	Evaluation Needs
1403	Evaluation Techniques
146	Faculty Evaluation
63	Formative Evaluation
(216)	Media Selection
166	Medical Evaluation
(581)	Performance Criteria
(181)	Performance Specifications
484	Personnel Evaluation
79	Preschool Evaluation
840	Program Effectiveness
4814	Program Evaluation
203	Psychological Evaluation
1221	Student Evaluation
71	Summative Evaluation
896	Teacher Evaluation
286	Textbook Evaluation
138	Textbook Selection
14,952	
(16,138)	

Science & Technology

109	Scientific Attitudes
373	Scientific Concepts
200	Scientific Enterprise
114	Scientific Literacy
182	Scientific Principles
(452)	Scientific Research
668	Technological Advancement
602	Technology
523	Theories

2,771

(3,223)

Data Analysis and Processing, Statistics & Other Analysis

54	Analysis of Covariance
701	Analysis of Variance
12	Bayesian Statistics
29	Cluster Analysis
155	Comparative Statistics
55	Component Analysis
617	Correlation
1002	Data Analysis
688	Data Collection
433	Electronic Data
157	Input-Output Analysis
872	Interaction Process Analysis
115	Linear Programming
190	Logic
492	Mathematical Models
142	Multiple Regression Analysis
26	Nonparametric Statistics
528	Predictive Validity
180	Predictor Variables
148	Probability
91	Probability Theory
91	Profile Evaluation
(199)	Sampling
1617	Statistical Analysis
10	Statistical Bias
1432	Statistical Data
198	Statistical Studies
251	Statistical Surveys
251	Statistics
1	Suppressor Variable
647	Systems Analysis
88	Tests of Significance
62	Transformations [Mathematics]
(273)	Validity
11, 335	
(11,807)	

Objectives and Criteria

218	Affective Objectives
223	Cognitive Objectives
208	Criteria
(142)	Criterion Referenced Tests
577	Course Objectives
79	Measurement Goals
376	Norms
915	Objectives
30	Psychomotor Objectives
581	Performance Criteria
181	Performance Specifications
282	Training Objectives

3,670

(3,812)

Tests, Measurement, Data Collection Instruments

14	Affective Tests
674	Aptitude Tests
431	Attitude Tests
202	Cognitive Measurement
130	Cognitive Tests
247	Comparative Testing
159	Community Surveys
142	Criterion Referenced Tests
50	Critical Incident Method
150	Educational Testing
44	Forced Choice Technique
614	Intelligence Tests
872	Interviews
343	Item Analysis
17	Item Banks
25	Item Sampling
872	Interaction Process Analysis
707	Measurement
(79)	Measurement Goals
1243	Measurement Instruments
1043	Measurement Techniques
43	Mental Tests
4	Multi-dimensional scales
214	Multiple Choice Texts
59	Nonverbal Tests
45	Norm Referenced Tests
(376)	Norms
112	Objective Tests
393	Observations
219	Performance Tests
530	Personality Assessment
300	Personality Tests
180	Post Testing
401	Predictive Ability [Testing]
337	Predictive Measurement
(180)	Predictor Variables
138	Pretesting
70	Pretests
48	Prognostic Tests
69	Projective Tests
367	Psychological Testing
213	Psychological Tests
174	Psychometrics
46	Q Sort
2713	Questionnaires
90	Scores
191	Scoring
34	Scoring Formulas
211	Screening Tests
3	Semantic Differential
143	Sociometric Techniques
448	Standardized Tests
2038	Surveys
1012	Test Construction
536	Test Interpretation
1041	Test Reliability
869	Test Results
50	Test Reviews
108	Test Selection
1301	Test Validity
28	Test Wiseness
1717	Testing
321	Testing Problems
270	Testing Programs
1163	Tests
92	Television Surveys
39	Timed Tests
36	True Scores
273	Validity
26,668	
(27,303)	

Methodology, Technique and Theory

106	Autoinstructional Methods
366	Case Studies
159	Community Surveys
993	Cost Effectiveness
381	Course Organization
50	Critical Incident Method
67	Critical Path Method
134	Cybernetics
1820	Decision Making
109	Deduction Methods
245	Documentation
724	Educational Technology
583	Educational Theories
330	Experimental Groups
440	Experiments
43	Flow Charts
557	Follow-up Studies
12	Force Field Analysis
168	Game Theory
302	Inductive Methods
821	Instructional Improvement
102	Instructional Systems
770	Instructional Technology
(872)	Interaction Process Analysis
1211	Interdisciplinary Approach
449	Laboratory Experiments
347	Laboratory Techniques
1536	Learning Theories
548	Longitudinal Studies
216	Media Technology
118	Mediation Theory
383	Methodology
2868	Models
644	Prediction
1755	Problem Solving
314	Program Budgetings
440	Program Costs
1684	Research Methodology
181	Research Tools
199	Sampling
210	Scientific Methodology
161	Search Strategies
91	Set Theory
1038	Simulations
(143)	Sociometric Techniques
(2038)	Surveys
(647)	Systems Analysis
5198	Teaching Methods
813	Teaching Procedures
31	Theoretical Criticism
523	Theories
30,270	
(33,970)	

Disciplines & Specialties

277	Anthropology
301	Educational Economics
352	Educational Psychology
240	Educational Sociology
(724)	Educational Technology
85	Experimental Psychology
367	Information Science
(770)	Instructional Technology
113	Labor Economics
278	Social Psychology
421	Sociology

2,434

(3,928)

Skills, Training, and Professional Education

502	Counselor Training
210	Decision Making Skills
649	Inservice Education
643	Institutes
255	Internship Programs
698	Job Training
202	Laboratory Training
524	Leadership Training
405	Management Development
258	Management Education
105	Management Games
316	Negro Education
332	On-the-Job Training
15	Performance Based Teacher Education
615	Post Secondary Education
440	Professional Continuing Education
661	Professional Education
458	Professional Training
15	Research Apprenticeships
131	Research Skills
64	Skill Analysis
864	Skill Development
91	Skills
315	Task Analysis
1282	Task Performance
65	Technical Writing
672	Training
(282)	Training Objectives
750	Training Techniques
11,537	
(11,819)	

Personnel

20	Audiovisual Directors
723	Change Agents
27	Clinical Professors
29	Courselor Selection
293	Employment Patterns
195	Employment Projections
230	Employment Statistics
334	Employment Trends
224	Extension Agents
(146)	Faculty Evaluation
18	Film Production Specialists
116	Guidance Personnel
25	Information Scientist
370	Job Analysis
114	Job Development
115	Job Market
755	Job Skills
249	Labor Force
260	Labor Market
86	Labor Supply
36	Labor Turnover
964	Manpower Development
734	Manpower Needs
547	Manpower Utilization
182	Media Specialists
115	Negro Employment
135	Negro Leadership
31	Negro Population Trends
356	Paraprofessional Personnel
319	Personnel
(484)	Personnel Evaluation
237	Personnel Needs
182	Personnel Policy
282	Personnel Selection
675	Professional Personnel
11	Psychometrists
180	Researchers
91	Scientific Manpower
81	Scientific Personnel
258	Scientists
175	Staff Improvement
313	Staff Utilization
13	Systems Analysts
79	Talent Development
77	Talent Identification
20	Talent Utilization
[5689]	Teacher Education
[201]	Teacher Selection
[190]	Teacher Supply and Demand
10,276	
[(16,986)]	

Content & Media

2517	Audiovisual Aids
574	Audiovisual Instruction
143	Autoinstructional Programs
411	Case Studies [Education]
395	College Curriculum
299	College Instruction
1378	Computer Assisted Instruction
980	Course Content
1816	Decision Making
314	Educational Games
274	Experimental Curriculum
969	Experimental Programs
183	Experimental Schools
267	Experimental Teaching
298	Field Experience Programs
(292)	Film Production
495	Instructional Films
1100	Films
305	Filmstrips
6	Instructor Centered Television
778	Mass Media
47	Media Selection
(216)	Media Technology
532	Multimedia Instruction
1976	Programmed Instruction
614	Program Materials
262	Programed Texts
54	Programed Units
1068	Simulation
101	Simulators
651	Tape Recordings
399	Teaching Machines
540	Televised Instruction
89	Television Curriculum
192	Transparencies
84	Textbook Bias
170	Textbook Content
124	Workbooks

20,405

(20,913)

APPENDIX C

ESTIMATION OF NUMBER OF DOCUMENTS IN THE RIE OR CIJE BASED ON FREQUENCY OF USE OF DESCRIPTORS AND IDENTIFIERS

Appendix B lists the counts for frequency of use of 379 selected descriptors and identifiers. The list is somewhat arbitrary. It could be pruned back to 100 or expanded to 500. We have suggested that, since the counts are made on a very large document base, the relative frequency of counts or sets of counts may be moderately stable and useful. For instance, while there are 3466 documents with the descriptor, "research," there are only 223 documents with the descriptor, "development." But if the "research" set of descriptors is compared with the "design and development" set, the total relative frequencies are 18.2 thousand to 12.9 thousand.

The problem with these counts is that they index "information" within documents. Since several kinds of information, calling for different descriptors, is contained in the same document, we know that the number of documents will be substantially smaller than the usage counts. How much smaller? Is there any way to estimate numbers of documents, given available counts of frequency of use of descriptors? This appendix describes our approach to this problem.

As an example, Table 1 indicates that 16 terms were classed under the heading, "policy, planning, change and innovation." There were 15.1 thousand uses of these 16 descriptors. This class accounts for 8.2% of the frequency counts for classes of descriptors listed in Table 1.

Taken together, the 98 descriptors under "policy, planning, change and innovation," plus the "R,D,D&E," account for 35.4% of the descriptor use frequency counts. These 98 descriptors were used over 65 thousand time in describing an estimated 16,000 to 29,000 documents and journal articles in ERIC.

The second "science and methodology" cluster, ranging from science and technology through statistics, objectives, methodology, theory, etc., involves 164 descriptors which were employed nearly 75 thousand times to describe an estimated 18,000 to 30,000 documents and journal articles.

The final cluster, which includes documents describing disciplines, skills, training, professional education, personnel, content, and media, involved 117 descriptors, which were applied nearly 45 thousand times to describe an estimated 11,000 to 18,000 documents and journal articles.

Overall, we estimate that ERIC alone now contains at least 45,000 items to which the 379 descriptors listed in Appendix B have been applied. The "RDD&E" collection alone (involving the 82 descriptors listed in Appendix B) is estimated at 14,000 to 22,000 items. Undoubtedly, many of these items may be of questionable quality, but it is evident that there is a remarkably large pertinent literature reflected in the ERIC collection. Since ERIC does not usually access commercially published items and probably misses a small fraction of other eligible items, our guess is that the number of pertinent items, published during the same period (approximately 1966-1972 for RIE and 1969-1972 for CIJE), may be 10% to 20% higher than our estimates for the ERIC collection alone.

We now turn to a description of our method for estimating the number of documents from descriptor counts. Lockheed Information Sciences provides periodic listings of RIE/CIJE descriptors and identifiers and their frequency of use. They are computer generated through their ERIC/DIALOG Retrieval System. The DIALOG system is capable of displaying counts for individual descriptors and sets of descriptors of nearly any degree of complexity. Hence the count of documents for a particular search, say all documents to which the descriptors

(research or development or evaluation) and (personnel or training or professional education) have been applied, can be obtained directly. However, the number of possible combinations for the 379 terms we have selected is 379 factorial, an impossibly large number.

We have thus used an indirect approach. Our first step was to establish the average number of descriptors and identifiers applied to appropriate samples of RIE/CIJE documents.

Our "population" consisted of 950 items that had been extracted from the ERIC base by applying sets of "RDD&E" terms as well as "personnel" and "training" terms in different combinations. Hence our population may be biased in not reflecting the entire ERIC file, but if there is a bias, the collection is more appropriate for our purposes.

Systematic samples of 100 RIE and 100 CIJE items were taken and the number of descriptors and identifiers assigned to each document was made. In making these counts, authors, agencies, countries, states, and dates were excluded. Our sample of RIE documents displayed a skewed distribution of descriptor counts.

One document had only three descriptors and one had twenty descriptors. The mean was 9.5 with a standard deviation of 3.8 and a standard error of the mean of 0.38. These data suggest that we may expect with practical confidence to find an average of 9 or 10 descriptors assigned to the typical "RDD&E" or "personnel and training" document.

The number of descriptors assigned to journal articles indexed in CIJE is significantly smaller,[1] with a range of one to ten descriptors, a mean of 6.1, a standard deviation of 3.9, and standard error of the mean of 0.20. We

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[1] The t-test for differences between RIE and CIJE means is over 8.0; while only 2.6 is needed at the .005 level (one tail).

have reasonable confidence of finding an average of 5 1/2 to 6 1/2 descriptors per CIJE journal item. In scanning these 200 sample RIE/CIJE citations, our impression was that possibly less than half of the descriptors were on our list of 379. No accurate match was made. If a relatively large number of descriptors (say 30 or more) are involved or where a smaller number, say ten or more closely associated descriptors are employed (e.g., Research, Scientific Research, Research Methodology, Methodology, Scientific Methodology, etc.), our advice would be to sum the descriptor use counts and divide by 4 if using RIE and divide by 3 if using CIJE to estimate, quite conservatively, the total number of items. These divisors are very rough estimates of the average number of descriptors from the selected set applied to the same documents. Where the number of descriptors is smaller (but at least ten) and the descriptors are relatively unrelated, then a divisor of 3 for RIE and 2 for CIJE may be more accurate.[2] These estimators will not be useful when only a small number of descriptors are employed or when a moderate number of descriptors with great variance in counts are involved. To illustrate, note that the number of documents with descriptors A or B or C, must be at least as large as the largest single count. For instance, Appendix B indicates that under the classification, "Design and Development," there are 950 uses of Curriculum Design, 4961 uses of Curriculum Development, and 216 uses of Design. We know that the number of documents using at least one of these descriptors must at least equal 4961. Dividing the total (6127) by a divisor of 2 or 3 makes no sense. Even for the 12,862 uses of 17 descriptors in the "Design and Development" class there are problems. Given the very large count for curriculum development and relatively large counts for program development and systems approach, three relatively unrelated terms, we

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[2] Often the counts are available for CIJE and RIE combined. Since the number of documents now in CIJE and RIE are roughly equal, one might take averages: say using a divisor of 3 1/2 if a very large number of items are involved, and 2 1/2 for moderate number, and possibly 1 1/2 for a relatively small number.

might estimate the number of documents indexed by this class of descriptors to be at least 8,000 and possibly over 10,000. Obviously, application of a divisor of 2 or 3 would lead to serious underestimates. On the other hand, consider the "Skills, Training and Professional Education" cluster. Here, there are 28 descriptors or identifiers and none has a count that is as high as 11% of the total count. In this case, a rough estimate of at least 3,000 ($\cong$11,819÷3.5) and possibly 5,000 ($\cong$11,819÷2.5) documents seems realistic

To summarize, it is possible to estimate roughly the number of documents in ERIC from the counts of frequency of use of descriptors. When the number of descriptors involved is small or a few descriptors account for a relatively large proportion of the total count, the estimates call for considerable guesswork and judgment. Conversely, when the number of descriptors is relatively large and the proportion of the total count represented by one or a few descriptors with high frequency of use is small, use of a divisor may be indicated. The value of the divisor may range between 1.5 and 4, depending on the total number of descriptors involved and the proportion of RIE to CIJE documents. Since CIJE documents tend to have an average of 6 descriptors and RIE documents average 9 1/2 descriptors, divisors of 2 or 3 will be more appropriate for CIJE, while 3 or 4 may be more appropriate for RIE. These divisors simply represent the estimated average number of times descriptors from the selected set will be applied to the same document. When highly accurate estimates are required, the ERIC/DIALOG or a similar system is needed. If the work must be done manually, one can use the ERIC Educational Documents Indexes and the CIJE Annual Cumulations. Working from the Indexes and the Cumulations is practical if the number of descriptors is not large. When the number is large, we suggest that sampling strategies be employed to reduce the task of matching only samples of the possible combinations of descriptors.

It should be noted that content in different areas is being accessed by ERIC at different rates. Although this is partially due to ERIC Central priorities and Clearinghouse policies, it undoubtedly reflects differential rates of knowledge documentation. Time and resources have not permitted extensive study of this area, but the data in Table 1 illustrate some short-term trends, based on ERIC accessions in the last six months of 1972.

TABLE 1

ACCESSIONS AND DESCRIPTORS FOR ERIC JULY-DECEMBER, 1972

Item	July Count	December Count	Increase	Rate
RIE (ED#1)	59,226	65,620	6,394	10.8%
CIJE (EJ#)	53,972	62,751	8,779	16.3
Total	113,198	128,371	15,173	13.4%
"Research"	18,525	20,933	2,408	13.0
"Design & Development"	11,196	12,862	1,666	14.9
"Evaluation"	13,328	15,969	2,641	19.8
Educational Development	465	681	216	46.5

The reader is cautioned that data over a longer time period should be employed to study trends. The data displayed in Table 1 do, however, illustrate the following: (a) over 15 thousand items were referenced in the six-month period, (b) CIJE items (journal references) are growing at a faster rate than RIE (technical reports) items, (c) the rate for the "research" group (See Appendix B for complete lists of descriptors.) is approximately the same as the total of RIE and CIJE, (c) the "design and development" descriptor group shows only a very slightly higher rate, (3) the "evaluation" group shows a markedly higher rate, and (f) the individual descriptor, educational development, shows a very high rate, but on a very small base.

The point of this analysis is to emphasize that estimates of the amount of information available for specific content areas will be conditioned by time. Documents pertaining to educational development and almost the entire "evaluation" group of descriptors are being accessed at higher rates than the relatively more established "research" group.

If there were more time, trends based on the past several years could have been developed and then used to make projections for a number of content areas. Such projections might be of use if content estimates were desired for several years hence.

APPENDIX D

ESTIMATION OF NUMBER OF BOOKS IN PRINT RELATED TO EDUCATIONAL RDD&E PERSONNEL AND TRAINING*

Policy, Planning, Change and Innovation

18	Community and School [Policy]
67	Education--Finance
81	Education
10	Education, Elementary --Aims and Objectives/ --Curriculum
70	Education, Higher --Aims and Objectives/ --Curriculum
12	Education, Secondary --Aims and Objectives/ --Curriculum
18	Education, Urban
59	Educational Innovations
40	Educational Planning
30	Education and State
17	Organizational Change
27	Planning
55	Political Psychology
16	Politics and Education
7	Public Opinion
46	School Management
139	Social Change
21	Social Policy
5	Social Science and State
738	

*Estimates based on counting selected book titles under subject headings listed on the following pages. Source is Subject Guide to Books in Print, 1972.

Research

6	Economic Research
42	Education Cost
108	Educational Research
	Education--Research
3	Interest--Psychology
68	Languages--Psychology
9	Learning and Scholarship
6	Library Science Research
31	Linguistic Research
22	Marketing Research
81	Operations Research
58	Organizational Research
5	Physical Education and Training--Research
30	Political Science Research
	Political Science--Research
23	Psychiatric Research
30	Psychological Research
68	Poverty Research
25	Reading--Psychology of
43	Research
14	Research Industrial
4	Research Libraries
(16)	Research Management
80	Social Science Research
31	Sociological Research
2	Sociology--Research
2	Textbooks
791	
(807)	

Design & Development

6	Communications--Audio Visual Aids
4	Design
2	Education
25	Education--Curricula
(4)	Filmstrips
(17)	Moving Pictures--Production and Direction
(9)	Moving Pictures--Editing
	Photography (over 100)
31	System Analysis
9	Systems Engineering
5	Textbook Preparation
82	
(112)	

Dissemination

61	Communication
5	Communication--Social Agent
16	Communication in Management
3	Communication in Medicine
15	Communication in Science/in Social Science
10	Communication of Technical Information
14	Communications Research
3	Diffusion of Innovations
4	Dissemination
14	Educational Exchanges
8	Information Storage and Retrieval
11	Information Storage and Retrieval --Education/ --Political Science/ --Science/ --Social Science
32	Information Services
27	Report Writing
53	Technical Writing
9	Technology--Information Services
2	Technology Transfer
29	Technology and Civilization
(59)	Educational Innovation
(27)	Technical Innovation
316	
(402)	

Evaluation

6	Education (including Elementary, Higher, and Secondary)
(2)	Job Evaluation
(10)	Employees, Rating of
(4)	Executives, Rating of
(19)	Grading and Marking (Students)
3	Occupational Training
4	Organization Research
2	Performance Criteria
1	Performance Specifications
2	School Management and Organization
3	Student Evaluation of Curriculum
13	Teachers, Rating of
2	Textbooks
7	Paperbound Titles

*****

28	Evaluation--Theory and Strategy*
10	Evaluation--Curriculum & Instruction*
8	Evaluation--Social*
3	Evaluation--Guidelines*
17	Evaluation--Causation & Impact*
109	
(144)	

*Note: These category titles are not as listed in Books in Print.

Science & Technology

26	Science (out of approximately 500)
(23)	Science Methodology
(7)	Science, As a Profession
23	Technology
49	
(79)	

Data Analysis and Processing, Statistics & Other Analysis

3	Analysis of Variance
15	Bayesian Statistical Decision Theory
3	Cluster Set Theory
14	Correlation (Statistics)
2	Data Processing
4	Decision Logic Tables
(35)	Decision Making--Mathematical Models
18	Dynamic Programming
18	Distribution (Probability Theory)
58	Econometrics
28	Economics--Mathematical
25	Educational Statistics
(4)	Educational Surveys
[>600]	Electronic Data Processing
22	Electronic Data Processing in Education
37	Experimental Design [Statistics]
12	Factor Analysis
1	Factorial Experiment Designs
1	Frequency Curves
8	Interindustry Economics [Input-Output Analysis]
(11)	Interaction Analysis in Education
3	Interative Methods--Mathematics
1	Latent Structure Analysis
60	Linear Programming
[≥200]	Logic
[≥100]	Matrices
(13)	Mathematical Models
190	Mathematical Statistics/ --Bibliography --Programmed Instruction/ --Tables
4	Monte Carlo Methods
16	Multivariate Analysis
9	Nonparametric Statistics
1	Order Statistics
10	Prediction--Psychology
[≥400]	Probability
43	Programming (Mathematics)
7	Regression Analysis
(31)	Sampling (Statistics)
(4)	Scale Analysis (Psychology)
5	Social Sciences--Statistics
7	Social Sciences--Statistical Methods
(15)	Social Surveys
6	Statistical Hypothesis Testing
45	Statistical Decision
338	Statistics
15	Statistics--Bibliography
8	Statistics--Charts, Tables
7	Statistics--Graphic Methods
12	Statistics--Programmed Instruction
3	Sequential Analysis
45	System Analysis (over 130)
20	Time Series Analysis
3	Transformations
1127	
[(>2540)]	

Objectives and Criteria

89	Aims and Objectives
2	Education
5	Education, Elementary --Aims and Objectives
31	Education, Higher --Aims and Objectives
11	Education, Secondary --Aims and Objectives
1	Motor Ability Testing (of 23)
5	Performance Criteria
3	Occupational Training (of 27)
147	

Tests, Measurement, Data Collection Instruments

19	Ability--Testing
7	Attitude Tests
3	Character Tests
14	Education Examinations, Questions, etc.
107	Educational Tests and Measurements
10	Employees, Rating of
29	Examinations
1	Executives--Ability Testing
4	Executives--Rating of
4	General Educational Development Tests
19	Grading and Marking (Students)
1	Intelligence Tests
3	Interviews
17	Interviewing
11	Interaction Analysis in Education
1	Mathematical Ability--Testing
7	Measure Theory
2	Mechanical Ability Testing
104	Mental Tests
2	Motivation (Psychology) Testing
5	Motor Ability Testing
6	Music Ability--Testing
1	Observations (Educational Method)
19	Personality Assessment
40	Personality Tests
10	Prediction
13	Prediction of Scholastic Success
11	Projection Tests
71	Psychometrics
3	Questioning
1	Questionnaires
4	Reading Ability Testing
4	Scale Analysis (Psychology)
7	Scholastic Aptitude Test
2	Sentence Completion Test
10	Sociometry
1	Surveys
4	Surveys, Educational
2	Surveys, Market
34	Surveys, Social
3	Testing
1	Vocabulary Tests
617	

Methodology, Technique, and Theory

3	Case Method
11	Cost Effectiveness
29	Critical Path Analysis
82	Cybernetics
150	Decision Making
12	Documentation
52	Education--Experimental Method
(37)	Experimental Design
1	Factorial Experimental Design
9	Flow Charts
1	Games, Theory of
83	Human Behavior
12	Human Engineering
14	Induction (Logic)
(11)	Interaction Process
[≅200]	Learning, Art of
101	Learning, Psychology of
	Logic
2	Market Surveys
	[Methodology--see under following discipline headings]
24	Anthropology--Methodology
18	Economics--Methodology
52	Education--Experimental Methods
1	Humanities--Methodology
31	Political Science Methodology
29	Psychology--Methodology
26	Science--Methodology [Selected from ≅75]
63	Social Sciences--Methodology
49	Sociology--Methodology
	[Models--see under following discipline headings]
23	Economic Development--Mathematical Models
45	Economics--Mathematical Models
2	Education--Mathematical Models
2	Human Behavior--Mathematical Models
10	Marketing--Mathematical Models
9	Mathematical Models
10	Political Science--Mathematical Models
9	Psychology--Mathematical Models
2	Social Psychology--Mathematical Models
15	Social Sciences--Mathematical Models
11	Sociology--Mathematical Models
7	PERT (network analysis)
23	Prediction
35	Problem Solving
12	Program Budgeting
10	Psychology--Experiments
21	Psychology--Experimental
31	Sampling
(4)	Scale Analysis (Psychology)
1	Searching--Bibliographical
2	Set Theory
37	Simulation Method
10	Sociometry
(45)	System Analysis
212	Teaching
12	Value Analysis
1406	

[(>1703)]

Disciplines & Specialties

18 of (≷800)	Economics
16[1]	Education and Sociology
22	Educational Anthropology
220	Educational Psychology
(25)	Educational Statistics
5 (of 20)	Information Sciences
13 (of 55)	Political Psychology
10	Political Science
3	Political Sociology
10 (of 42)	Psychology--Experimental
3	Technology--Education
61 of 315	Social Psychology
15 of 122	Social Sciences
60 of≷700	Sociology
13	Technology
614	

Skills, Training, and Professional Education

1	Education
36	Employees, Training of
10	Executives, Training of
4	Industrial Management
4	Interns (Education)
2	Job Analysis
2	Job Description
2	Job Evaluation
18	Job Satisfaction
16	Management, Study & Teaching/Case Studies
18	Management Games
5	Negroes--Education
28	Occupational Training
4	Psychology, Industrial
9	Professional Education
3	Retraining, Occupational
7	Technical Education
169	

Personnel

14	Agricultural Extension [Extension Agent]
3	Educational Media Personnel
2	Guidance Student
12	Industrial Management
2	Industrial Management--Research
10	Industrial Sociology
1	Job Vacancies
11	Labor Supply
5	Labor Turnover
12	Manpower Policy
20	Organization
10	Organizational Research
6	Negroes Employment
4	Occupational Mobility
(28)	Occupational Training
12	Occupations
9	Professional Education
16	Professions
25	Personnel Management
3	Psychology, Applied
40	Psychology, Industrial
3	Psychology as a Profession
1	Research as a Profession
18	Research, Industrial Management
7	Science as a Profession
2	Scientists, Employment
9	Scientists
20	Social Groups
3	Women--Employment
[123]	Teachers, Training of/ Inservice Training
[6]	Teacher Selection
[4]	Teacher Supply and Demand
280	
[(441)]	

Content and Media

25	Audiovisual Education
22	Audiovisual Materials
3	Case Method
6	Communication--Audio-Visual Aids
1	Communication--Bibliography
13	Computer Assisted Instruction
113	Education--Curricula
(49)	Education--Experimental Methods
7	Education, Higher--Curricula
12	Education, Primary--Curricula
12	Education, Secondary--Curricula
17	Educational Games
2	Lantern Slides
15	Moving Pictures in Education
27	Programmed Instruction
8	Radio in Education/in Adult Education
(37)	Simulation Method
10	Sound--Recording and Reproducing
59	Teaching--Aid and Devices
8	Teaching Machines
3	Technical Education
30	Television in Education
28	Textbooks
10	Visual Aids
4	Visual Education
435	
(521)	